

CLAIMS

72. (Amended) A laser for emitting pulsed electromagnetic radiation, said laser comprising:

an optical resonator;

a solid-state laser gain medium, said solid-state laser gain medium being placed inside said
5 optical resonator,

said laser gain medium having two end faces, and at least one of said end faces comprising a
cooling surface;

means for cooling said laser gain medium via said cooling surface;

means for exciting said laser gain medium to emit electromagnetic radiation; and

10 means for passive mode locking comprising a saturable absorber placed inside said optical
resonator, such that when said optical resonator, said solid-state laser gain medium, and said
means for passive mode locking are designed and arranged in a manner that, once said laser
gain medium is excited by said exciting means for exciting said laser gain medium, pulsed laser
radiation is caused to propagate within said optical resonator the laser emits a continuous train of
15 electromagnetic radiation pulses.

73. (Previously presented) The laser according to claim 72, wherein said laser gain medium
is in the shape of a thin plate or layer with two end faces, the extension of said end faces being
greater than a thickness of said plate or layer measured essentially in a direction perpendicular to
one of said end faces.

20 74. (Previously presented) The laser according to claim 72, wherein at least one of said end

faces is provided with means for reflecting said emitted electromagnetic radiation.

75. (Previously presented) The laser according to claim 74, wherein said reflecting means comprises a dielectric coating.

5 76. (Previously presented) The laser according to claim 72, wherein said laser gain medium is selected from the group consisting of YbYAG, NdYAG, NdYVO₄, and a semiconductor material.

77. (Previously presented) The laser according to claim 72, wherein said laser gain medium has a thickness such that the effect of spatial hole burning supports the generation of short pulses.

10 78. (Previously presented) The laser according to claim 72, wherein said optical resonator is designed such that said emitted electromagnetic radiation hits said thin-disk gain medium twice during each round-trip in said optical resonator.

15 79. (Previously presented) The laser according to claim 72, wherein said optical resonator is designed such that said emitted electromagnetic radiation hits said thin-disk gain medium more than two times during each round-trip in said optical resonator, whereby at least two hits with different angles of incidence occur such that a standing-wave pattern in said thin-disk gain medium is at least partially smeared out.

80. (Previously presented) The laser according to claim 72, wherein said saturable absorber is a semiconductor saturable absorber mirror device.

20 81. (Previously presented) The laser according to claim 72, wherein said means for passive mode locking comprises means for Kerr lens mode locking.

82. (Previously presented) The laser according to claim 72, further comprising means for

introducing negative dispersion or dispersion compensation placed inside said optical resonator.

83. (Previously presented) The laser according to claim 82, wherein said dispersion-compensating means is a Gires-Tournois interferometer, a pair of diffraction gratings, a pair of prisms, or a dispersive mirror.

5 84. (Previously presented) The laser according to claim 72, wherein said optical resonator has a length which is designed in a manner that pulsed electromagnetic radiation at a repetition rate lower than 100 MHz is emitted.

85. (Previously presented) The laser according to claim 72, wherein said exciting means comprises an electromagnetic-radiation source.

10 86. (Previously presented) The laser according to claim 72, further comprising means for cavity dumping.

87. (Previously presented) The laser according to claim 72, further comprising means for Q-switched mode locking.

15 88. (Amended) An apparatus for emitting pulsed electromagnetic radiation, said apparatus comprising a laser, said laser comprising

an optical resonator;

a solid-state laser gain medium, said solid state laser gain medium being placed inside said optical resonator,

20 said laser gain medium having two end faces, and at least one of said end faces comprising a cooling surface;

means for cooling said laser gain medium via said cooling surface;

means for exciting said laser gain medium to emit electromagnetic radiation; and

means for passive mode locking comprising a saturable absorber placed inside said optical resonator, such that when said optical resonator, said solid-state laser gain medium, and said means for passive mode locking are designed and arranged in a manner that, once said laser gain medium is excited by said means for exciting said laser gain medium, pulsed laser radiation is caused to propagate within said optical resonator the laser emits a continuous train of electromagnetic radiation pulses,

the apparatus further comprising frequency-conversion means for an optically nonlinear

frequency conversion of electromagnetic radiation emitted by said laser.

89. (Previously presented) The apparatus according to claim 88, wherein said frequency-conversion means comprises at least one of the following: a synchronously pumped optical parametric oscillator (OPO), a frequency doubler, a sum frequency mixer, an optical parametric generator (OPG), and an optical parametric amplifier (OPA).

15 90. (Previously presented) The apparatus according to claim 89, wherein said frequency-conversion means comprises a synchronously pumped optical parametric oscillator (OPO) and a frequency doubler, a sum frequency mixer, an optical parametric generator (OPG) or an optical parametric amplifier (OPA), for generating pulsed red, green and blue light.

91. (Previously presented) The apparatus according to claim 88, wherein said frequency-conversion means comprises an optically nonlinear crystal with defined principal axes, said apparatus further comprising means for adjusting the propagation angle of said laser radiation in said crystal with respect to said principal axes in order to obtain phase matching of the nonlinear conversion process.

92. (Amended) A method for generating pulsed laser radiation, comprising the steps of:

exciting a solid-state laser gain medium to emit electromagnetic radiation, said laser gain medium having two end faces, and at least one of said end faces comprising a cooling surface;

cooling said laser gain medium via said cooling surface;

5 recirculating said electromagnetic radiation in an optical resonator; and

passively mode locking said electromagnetic radiation using a saturable absorber;

wherein said steps are carried out in a manner that a continuous train of laser pulses is generated.

93. (Previously presented) The method according to claim 92, wherein said electromagnetic radiation is mode locked by a saturable absorber and/or by Kerr lens mode locking.

10 94. (Previously presented) The method according to claim 92, wherein negative dispersion is introduced to inside said optical resonator.

95. (Previously presented) The method according to claim 92, wherein pulsed electromagnetic radiation is emitted at a repetition rate lower than 100 MHz, and preferably lower than 50 MHz.

15 96. (Previously presented) The method according to claim 92, wherein said laser gain medium is excited by electromagnetic radiation.

97. (Previously presented) The method according to claim 92, wherein said electromagnetic radiation in said optical resonator is cavity dumped.

98. (Previously presented) The method according to claim 92, wherein the thickness of the gain medium is chosen such that the effect of spatial hole burning supports the generation of short pulses.

99. (Previously presented) The method according to claim 92, wherein said emitted 5 electromagnetic radiation hits said thin-disk gain medium twice during each round-trip in said optical resonator.

100. (Previously presented) The method according to claim 92, wherein said emitted electromagnetic radiation hits said thin-disk gain medium more than two times during each round-trip in said optical resonator, whereby at least two hits with different angles of incidence 10 occur such that a standing-wave pattern in said thin-disk gain medium is at least partially smeared out.

101. (Previously presented) The method according to claim 92, wherein said electromagnetic radiation in said optical resonator is Q-switched mode locked, preferably by using a saturable absorber with a large modulation depth.

102. (Previously presented) A method for generating pulsed electromagnetic radiation, said 15 method comprising the steps of generating laser radiation by:

exciting a solid-state laser gain medium to emit electromagnetic radiation, said laser gain medium having two end faces, and at least one of said end faces comprising a cooling surface;

cooling said laser gain medium via said cooling surface;

20 recirculating said electromagnetic radiation in an optical resonator; and

passively mode locking said electromagnetic radiation using a saturable absorber; and

wherein said steps are carried out in a manner that a continuous train of laser pulses is generated and further comprising optically nonlinearly converting the frequency of said laser radiation.

103. (Previously presented) The method according to claim 102, wherein the frequency of said laser radiation is converted by one or more of an optical parametric oscillator (OPO), a frequency doubler, a sum frequency mixer, an optical parametric generator (OPG), and an optical parametric amplifier (OPA).

104. (Previously presented) The method according to claim 103, wherein said laser radiation is converted by an optical parametric oscillator (OPO) and by a frequency doubler, a sum frequency mixer, an optical parametric generator (OPG) or an optical parametric amplifier (OPA), and thus pulsed red, green and blue light is generated.

105. (Previously presented) The method according to claim 102, wherein the frequency is converted in an optically nonlinear crystal with defined principal axes, and phase matching of the nonlinear conversion process is obtained by adjusting the propagation angle of said laser radiation in said crystal with respect to said principal axes.

106. (Amended) A method for generating pulsed electromagnetic radiation and for varying, by a defined scaling factor, the output power of said pulsed electromagnetic radiation, said method comprising the steps of

exciting, with an exciting power, a solid-state laser gain medium to emit electromagnetic radiation, said laser gain medium having two end faces, and at least one of said end faces comprising a cooling surface;

cooling said laser gain medium via said cooling surface;

recirculating said electromagnetic radiation in an optical resonator; and

passively mode locking said electromagnetic radiation using a saturable absorber,

~~wherein said steps are carried out in a manner that a continuous train of laser pulses is generated~~

and further comprising the steps of:

5 varying essentially by said scaling factor the exciting power;

varying essentially by said scaling factor the area illuminated by said electromagnetic radiation in said laser gain medium; and

varying essentially by said scaling factor the area illuminated by said electromagnetic radiation on said mode-locking means.

10 107. (Previously presented) The method according to claim 106, wherein said solid state gain medium is excited by pumping electromagnetic radiation, and wherein the exciting power is a pump power of said pumping electromagnetic radiation.